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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/579,402 | 05/25/2000 | KEI-YU KO | 11675.114.1 | 7953 |

21567 7590 09/15/2003

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EXAMINER

LEE, EUGENE

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
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2815

DATE MAILED: 09/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/579,402

Applicant(s)

KO, KEI-YU

Examiner

Eugene Lee

Art Unit

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-- Th MAILING DATE of this communication app ars on the cov r sh t with th correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 June 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 27.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/5/03 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 3, 5 thru 8, 11, 13, and 15 thru 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bronner 5,792,703 in view of Lee et al. 5,192,703 in view of Hsue 5,430,328. Bronner discloses (see, for example, FIG. 5) a gate stack 60 comprising a gate insulating layer (gate oxide layer), gate electrode (gate layer), insulating sidewall spacers (spacer) and a cap insulator (silicon dioxide cap) wherein the gate stack is formed on a substrate (semiconductor material layer) 50. A connecting stud (contact plug) 80' resides in an insulator (layer of doped silicon dioxide) 85'. Bronner does not disclose a layer of refractory metal silicide on said gate layer. Lee discloses (see, for example, FIG. 22) a gate stack structure comprising a metal silicide layer 15 on top of a gate layer 10. The metal silicide layer reduces the resistance of the gate

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electrode. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include the metal silicide layer in Bronner's invention in order to reduce the resistance of the gate electrode.

Bronner does not disclose a conductive layer being disposed along said lateral wall of said contact plug. Lee discloses (see, for example, FIG. 22) a contact plug structure comprising a tungsten fill 90 and TiN layer (conductive layer) 85. The TiN layer is a diffusion barrier providing a barrier between the N⁺ junction and the tungsten fill. The TiN layer also provides a low contact resistance. See, for example, column 6, lines 59-*. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to include the TiN layer in Bronner's invention in order to provide a diffusion barrier and also to reduce the contact resistance.

Bronner in view of Lee does not disclose the conductive layer as being a refractory metal silicide. However, Hsue discloses (see, for example, FIG. 8) a semiconductor device comprising a barrier layer (conductive layer) 20, tungsten contact 22, and insulating layer 16. In column 2, line 67-column 3, line 14, Hsue discloses the barrier layer being titanium silicide/titanium nitride as well as Ti/TiN. Hsue further discloses the barrier layer as improving the adhesion between the tungsten and the substrate. The barrier layer also prevents aluminum spiking. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use titanium silicide/titanium nitride in Bronner in view of Lee in order to improve the adhesion between the substrate and the connecting stud, and also to prevent aluminum spiking.

Regarding the limitation “doped silicon dioxide” and claim 6, see, for example, column 4, lines 17. Regarding the limitation that the cap insulator is made of silicon dioxide, see, for example, column 3, lines 19-22.

Regarding claims 3 and 7, Bronner does not disclose the nonconductive material as being undoped silicon dioxide. Lee discloses (column 5, line 53) that the nonconductive material may be silicon dioxide. Silicon dioxide has excellent insulative properties. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to use silicon dioxide, since silicon dioxide has excellent insulative properties and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claim 5, see, for example, column 5, line 42 of Lee.

Regarding claim 8, see, for example, column 3, line 17 of Bronner.

4. Claims 2 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bronner ‘703 in view of Lee ‘703 in view of Hsue ‘328 as applied to claims 1, 3, 5 thru 8, 11, 13, and 15 thru 18 above, and further in view of Havemann 5,482,894. Bronner in view of Lee in view of Hsue does not disclose the nonconductive material comprising silicon nitride. However, Havemann teaches (see, for example, column 2, line 66) that many different insulative materials (such as silicon dioxide) may be used in the spacers of a gate stack structure. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to use silicon nitride, since silicon nitride has excellent insulative properties and it has been held to be within the

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general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

5. Claims 4 and 9, 10, 14, 19, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bronner '703 in view of Lee et al. '703 in view of Hsue '328 as applied to claims 1, 3, 5 thru 8, 11, 13, and 15 thru 18 above, and further in view of Ahmad et al. 5,208,176. Bronner in view of Lee in view of Hsue does not disclose the semiconductor material being made of monocrystalline silicon. However, Ahmad discloses (see, for example, column 3, lines 39-43) that DRAM semiconductor devices are typically formed on monocrystalline silicon. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use monocrystalline silicon in Bronner in view of Lee in view of Hsue in order to have a substrate suitable for a semiconductor device with minimum crystal defect and a smooth surface.

Response to Arguments

6. Applicant's arguments filed 6/5/03 have been fully considered but they are not persuasive.

In column 3, lines 7-8, Hsue states that the barrier layer may be titanium silicide/titanium nitride as well as titanium/titanium nitride.

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INFORMATION ON HOW TO CONTACT THE USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 703-305-5695. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 703-308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Eugene Lee
September 6, 2003

A handwritten signature in black ink, appearing to read 'Eddie Lee', with a large, sweeping loop at the top.

EDDIE LEE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800